



Office of Energy Efficiency
and Renewable Energy



Intelligent Induction-Hardening Process Controller for Manufacturing Automotive Parts

Background

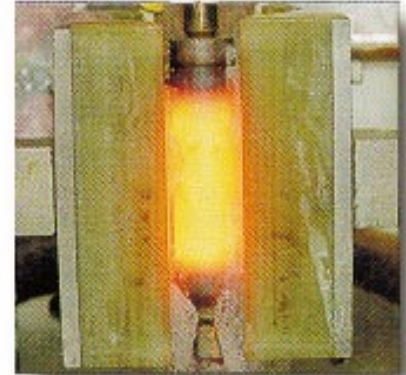
Induction hardening is a fast, inline heat-treating process that applies energy directly to steel parts that require a hard (case-hardened) surface. Induction hardening is widely used in the automobile industry to case-harden steel parts that are used in high-wear environments. Such parts include shafts, gears, bearings, and valve seats. For decades, the ability to control the depth and quality of case-hardened surfaces when using the induction-hardening process has eluded materials engineers. The U.S. Department of Energy's Sandia National Laboratories, using knowledge and experience developed from materials modeling and characterization studies related to defense programs, has partnered with domestic automakers to develop a neural-network-based process controller to precisely control the depth and quality of case-hardened surfaces on steel parts that are exposed to high wear.

Accomplishments

- ◆ Transferred process controller technology from the laboratory into a high-production manufacturing environment.
- ◆ Delphi Saginaw Steering Systems is currently producing intermediate axial shafts for General Motors Saturn vehicles that are case-hardened with the new process controller.
- ◆ Ford Motor Company has installed and is evaluating a similar controller for induction-hardening process control in their manufacturing facilities.

Benefits

- ◆ The improved process control technology enables the manufacture of components with a higher strength-to-weight ratio, which reduces component weight.



*Metal Automotive Part Being Heated
in an Induction Heating Coil*

- ◆ The depth of case-hardening is controlled with a precision five times better than that of existing induction-hardening controllers, which reduces the amount of scrapped parts.
- ◆ The system includes online monitoring of the parts being case-hardened, which eliminates the costly quality control testing required with other processing methods.

Future Activities

- ◆ Advance the process control technology to permit case-hardening of automotive components that have complex shapes.
- ◆ Transfer the process control technology to other industries that use the induction-hardening process, such as the steel and forging industries and heavy equipment manufacturers.

Partners in Success

Sandia National Laboratories
General Motors Corporation
Delphi Saginaw Steering Systems

Contact

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